

WHAT IS CLAIMED IS:

1. A three-dimensional image grabber comprising:
a pattern projecting assembly for simultaneously projecting
5 at least two phase-shifted patterns onto an object; each of said projected
patterns being characterized by a predetermined bandwidth; and
an image acquisition apparatus sensitive to said
predetermined bandwidths for simultaneously taking an image of each of
said projected patterns on the object.
10
2. A three-dimensional image grabber as recited in claim 1,
wherein at least one of said predetermined bandwidth includes a single
wavelength.
- 15 3. A three-dimensional image grabber as recited in claim 1,
wherein said pattern projection assembly includes a semi-transparent
plate including a pattern to be illuminated by an illuminating assembly, a
spectral splitter to be positioned between said plate and said illuminating
assembly and a projector for projecting said illuminated plate onto said
20 object; said illuminating assembly including a source of white light so
positioned as to be projected through said plate.
- 25 4. A three-dimensional image grabber as recited in claim 3,
wherein said illuminating assembly further includes an optical fiber and a
condenser for bringing light from said white source to said plate.

5. A three-dimensional image grabber as recited in claim 3, wherein said semi-transparent plate is a grid.

6. A three-dimensional image grabber as recited in claim 1,
5 wherein said pattern projection assembly includes at least two pattern projecting apparatuses and a reflecting arrangement; each of said pattern projecting apparatus being configured to project a light having a predetermined bandwidth through a pattern; said reflecting arrangement being so configured as to direct said projected patterns along a common
10 direction of incidence.

7. A three-dimensional image grabber as recited in claim 6, wherein at least one of said pattern projecting apparatuses includes a semi-transparent plate including a pattern to be illuminated by an
15 illuminating assembly and a projector for projecting said illuminated plate onto said reflecting arrangement; said illuminating assembly including a source of light having a predetermined bandwidth and being so positioned as to be projected through said plate.

20 8. A three-dimensional image grabber as recited in claim 6, wherein said projecting arrangement includes at least one of said a mirror and a semi-transparent mirror.

9. A three-dimensional image grabber as recited in claim 6,
25 wherein said plate is a grid.

10. A three-dimensional image grabber as recited in claim 6, wherein said pattern projecting apparatuses are so positioned relative to each other as to each provide the same distance from said respective plate to the object.

5

11. A three-dimensional image grabber as recited in claim 1, wherein said image acquisition apparatus includes at least one camera sensitive to said predetermined bandwidth.

10

12. A three-dimensional image grabber as recited in claim 11, wherein said image acquisition apparatus includes a telecentric lens.

15

13. A three-dimensional image grabber as recited in claim 1, wherein said image acquisition apparatus includes at least two cameras, each sensitive to one of said predetermined bandwidth.

20

14. A three-dimensional image grabber as recited in claim 11, wherein said camera is selected from the group consisting of a Charge Coupled Device (CCD) camera and a Complementary Metal-Oxide-Silicon (CMOS) device.

15. A system for measuring the relief of an object, said system comprising:

25 a pattern projecting assembly for simultaneously projecting at least three phase-shifted patterns onto the object; each of said projected patterns being characterized by a predetermined bandwidth;

an image acquisition apparatus sensitive to said predetermined bandwidths for taking an image of each of said at least three phase-shifted projected patterns on the object; each of said images including a plurality of pixels having intensity values; and

5 a controller configured for:

a) receiving from the image acquisition apparatus said at least three images of the projected patterns onto the object;

b) computing the object phase for each pixel using the at least three object intensity values for the corresponding pixel; and

10 c) computing the relief of the object at each pixel position using said object phase at the corresponding pixel position.

16. A system as recited in claim 15, wherein said pattern projecting assembly includes a grid illuminated by an illuminating assembly, a spectral splitter to be positioned between said grid and said illuminating assembly and a projector for projecting said illuminated grid onto said object; said illuminating assembly including a source of white light so positioned as to be projected through said grid.

20 17. A system as recited in claim 15, wherein said pattern projection assembly includes at least two pattern projecting apparatuses and a reflecting arrangement; each of said pattern projecting apparatus being configured to project a light having a predetermined bandwidth through a pattern; said reflecting arrangement being so configured as to
25 direct said projected patterns along a common direction of incidence.

18. A system as recited in claim 15, wherein said image acquisition apparatus includes at least one camera sensitive to said predetermined bandwidths.

5 19. A system as recited in claim 15, wherein said computer includes memory means for storing said images during their process.

10 20. A system as recited in claim 15, wherein said computer includes at least one of a storing device, an input device and an output device.

 21. The use of the system of claim 15, for lead-coplanarity inspection.

15 22. A method for measuring the relief of an object comprising:

 d) simultaneously projecting at least three phase-shifted patterns onto the object;

20 e) taking an image of each of said at least three phase shifted patterns on the object to gather an intensity value at pixel positions on said image;

 c) computing the object phase for each of said pixel positions using the at least three object intensity values for the corresponding pixel; and

25 d) computing the relief of the object at each pixel position using said object phase at the corresponding pixel position.

23. A method as recited in claim 22, wherein said at least three images are taken simultaneously.

24. A three-dimensional image grabber comprising:

- 5 a means for simultaneously projecting at least two phase-shifted patterns onto the object; each of said projected patterns being characterized by a predetermined bandwidth; and
- a means for simultaneously taking an image of each of said projected patterns on the object; said image taking means being sensitive
- 10 to said predetermined bandwidths.